GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Signal analysis, PG_00060218		
Field of study	Technical Physics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Theoretical Physics and Quantum Computing -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Marek Czachor	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	15.0	45

E-learning hours included: 0.0

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=1205

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	45	5.0	25.0	75

Subject objectives

Introduction to Fourier and wavelet analysis

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U08] can prepare written works and speeches in Polish and English, concerning detailed issues of physics and related fields, and scientific disciplines	The ability to prepare a written thesis that meets the requirements of a diploma thesis or scientific publication.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[K6_W05] has knowledge of programming methodology and techniques, and the use of selected IT tools in physics and technology	Ability to apply modern programming techniques, in particular using artificial intelligence.	[SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation
[K6_U07] presents facts within the scope of physics and other scientific disciplines in a clear manner	The ability to apply theoretical principles to prepare simple illustrations of sound and image analysis.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[K6_W07] has knowledge of the construction and operation of physical instruments, measurement and research equipment	Knowledge of theoretical basis of Fourier and wavelet analysis.	[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Course content – lecture
Lecture

1. Signal as a vector, signal analysis as a change of basis, scalar products and unitarity, resolutions of unity
2. Discrete Fourier transforms: complex, fast, cosine
3. Consequences of unitarity: Parseval's and Plancherel's theorems
4. Fourier transform on an interval and a line
5. Shannon's sampling theorem; Shannon's wavelet
6. Windowed Fourier transform; bases and frames
7. Fast Haar transform
8. Subband coding; downsampling and upsampling
9. Lowpass and highpass filters
10. Bi-orthogonality
11. From filters to wavelets
12. Compression

Seminar

1. Application of discrete Fourier transform to sound analysis
2. Two-dimensional Fourier transform applied to image compression
3. 2-dimensional Haar transform applied to image compression
4. Gibbs phenomenon and its minimization applied to a selected discontinuous signal
5. Sound analysis using windowed transform</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Knowledge of elementary theory of Hilbert spaces and complex analysis</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>seminar</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>lecture</td><td>60.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>J. T. Białasiewicz, Falki i aproksymacje, WNT, Warszawa 2000 P. Wojtaszczyk, Teoria falek, PWN, Warszawa, 2000 G.Kaiser, A Friendly Guide to Wavelets, Birkhauser, Boston, 1995</td></tr>
<tr><td>Supplementary literature</td><td>No requirements</td></tr>
<tr><td>eResources addresses</td><td>Basic
https://enauczanie.pg.edu.pl/2025/course/view.php?id=1205 - Pdf files of the lectures, supplemented by comments in mp4 format</td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>Types of discrete Fourier transforms

Scheme of multiresolution analysis

Prove Shannon's sampling theorem</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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